

## **LISTING OF THE CLAIMS**

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. **(Withdrawn)** An optical transmission system, comprising:  
one or more first light sources for Raman amplification that amplify signal light transmitting in an optical transmission line; and  
one or more second light sources for Raman amplification that are disposed at the positions adjoining said one or more first light sources for Raman amplification via said optical transmission line, wherein:  
each of said one or more first light sources for Raman amplification, comprising:  
a first pumping light source that emits first pumping light at a normal time as a pumping light source; and  
a first optical multiplexer that inputs said first pumping light to said optical transmission line, and  
each of said one or more second light sources for Raman amplification, comprising:  
a second pumping light source that emits second pumping light of the same wavelength band of said first pumping light at a normal time as a pumping light source;  
a spare pumping light source that emits spare pumping light of the same wavelength band of said first pumping light based on necessity;  
an optical coupler that couples said second pumping light and said spare pumping light; and  
a second optical multiplexer that inputs said coupled pumping light to said optical transmission line, wherein:  
in case that a failure occurred at said first or second pumping light source, said spare pumping light source is worked and said spare pumping light is emitted.

2. **(Withdrawn)** An optical transmission system, comprising:

one or more first light sources for Raman amplification that amplify signal light transmitting in an optical transmission line; and

one or more second light sources for Raman amplification that are disposed at the positions adjoining said one or more first light sources for Raman amplification via said optical transmission line, wherein:

each of said one or more first light sources for Raman amplification, comprising:

plural first pumping light sources that emit plural first pumping light whose wavelengths are different from each other at a normal time, as pumping light sources;

a first optical multiplexer that multiplexes said plural first pumping light; and

a second optical multiplexer that inputs said multiplexed first pumping light to said optical transmission line, and

each of said one or more second light sources for Raman amplification, comprising:

plural second pumping light sources that emit plural second pumping light whose wavelengths are the same ones corresponding to said plural first pumping light sources at a normal time, as pumping light sources;

plural spare pumping light sources that emit plural spare pumping light whose wavelengths are the same ones corresponding to said plural second pumping light sources based on necessity;

plural optical couplers that couple said second pumping light and said spare pumping light of the same wavelength band;

a third optical multiplexer that multiplexes plural coupled pumping light whose wavelengths are different from each other; and

a fourth optical multiplexer that inputs multiplexed pumping light to said optical transmission line, wherein:

in case that a failure occurred at one in said plural first or plural second pumping light sources, said spare pumping light source whose wavelength band is the same one that said failure occurred is worked and said spare pumping light is emitted.

3. **(Withdrawn)** An optical transmission system in accordance with claim 1, wherein:

in case that a failure occurred at said first or second pumping light source, said spare pumping light is emitted from said spare pumping light source so that the output level of said signal light becomes the same output level before said failure occurred.

4. **(Withdrawn)** An optical transmission system in accordance with claim 2, wherein:

in case that a failure occurred at one in said plural first or plural second pumping light sources, said spare pumping light is emitted from corresponding one of said plural spare pumping light sources so that the output level of said signal light becomes the same output level before said failure occurred.

5. **(Withdrawn)** An optical transmission system in accordance with claim 1, wherein:

in case that a failure occurred at said first or second pumping light source, said spare pumping light is emitted from said spare pumping light source so that the gain wavelength characteristic of said signal light becomes the same gain wavelength characteristic before said failure occurred.

6. **(Withdrawn)** An optical transmission system in accordance with claim 2, wherein:

in case that a failure occurred at one in said plural first or plural second pumping light sources, said spare pumping light is emitted from corresponding one of said plural spare pumping light sources so that the gain wavelength characteristic of said signal light becomes the same gain wavelength characteristic before said failure occurred.

7. **(Withdrawn)** An optical transmission system in accordance with claim 1, wherein:

each of said one or more first light sources for Raman amplification, further comprising:  
a control circuit that controls said first pumping light source, and  
each of said one or more second light sources for Raman amplification, further  
comprising:  
a control circuit that controls said second pumping light source and said spare pumping  
light source.

**8. (Withdrawn)** An optical transmission system in accordance with claim 2,  
wherein:  
each of said one or more first light sources for Raman amplification, further comprising:  
a control circuit that controls said plural first pumping light sources, and  
each of said one or more second light sources for Raman amplification, further  
comprising:  
a control circuit that controls said plural second pumping light sources and said plural  
spare pumping light sources.

**9. (Withdrawn)** An optical transmission system, comprising:  
one or more light sources for Raman amplification not having a redundancy system that  
amplify signal light transmitting in plural optical transmission lines; and  
one or more light sources for Raman amplification having a redundancy system that are  
disposed at the positions adjoining said one or more light sources for Raman amplification not  
having said redundancy system via said plural optical transmission lines, wherein:  
each of said one or more light sources for Raman amplification not having said  
redundancy system, comprising:  
plural first pumping light sources that emit first pumping light whose wavelengths are  
different from each other at a normal time, as pumping light sources;  
a first means that multiplexes said plural first pumping light and splits multiplexed  
pumping light into plural pumping light; and

plural first optical multiplexers that input split pumping light to said plural optical transmission lines, and

each of said one or more light sources for Raman amplification having said redundancy system, comprising:

plural second pumping light sources that emit second pumping light whose wavelengths are the same ones of said plural first pumping light sources at a normal time, as pumping light sources;

plural spare pumping light sources that emit spare pumping light whose wavelength bands are the same ones corresponding to said plural first pumping light sources, based on necessity;

plural optical couplers that couple said second pumping light and said spare pumping light of the same wavelength band;

a second means that multiplexes plural coupled pumping light whose wavelengths are different from each other and splits multiplexed pumping light into plural pumping light; and

plural second optical multiplexers that input split pumping light to said plural optical transmission lines, wherein:

in case that a failure occurred at one in said plural first pumping light sources in said one or more light sources for Raman amplification not having said redundancy system or at one in said plural second pumping light sources in said light sources for Raman amplification having said redundancy system, said spare pumping light source whose wavelength band is the same one that said failure occurred is worked and said spare pumping light is emitted.

**10. (Withdrawn)** An optical transmission system, comprising:

one or more light sources for Raman amplification not having a redundancy system that amplify signal light transmitting in plural optical transmission lines; and

one or more light sources for Raman amplification having a redundancy system that are disposed at the positions adjoining said one or more light sources for Raman amplification not having said redundancy system via said plural optical transmission lines, wherein:

each of said one or more light sources for Raman amplification not having said redundancy system, comprising:

plural first pumping light sources that emit first pumping light whose wavelengths are different from each other at a normal time, as pumping light sources;

a first means that multiplexes said plural first pumping light and splits multiplexed pumping light into plural pumping light; and

plural first optical multiplexers that input split pumping light to said plural optical transmission lines, and

each of said one or more light sources for Raman amplification having said redundancy system, comprising:

plural second pumping light sources that emit second pumping light whose wavelengths are the same ones of said plural first pumping light sources at a normal time, as pumping light sources;

plural spare pumping light sources that emit spare pumping light whose wavelength bands are the same ones corresponding to said plural first pumping light sources, based on necessity;

plural optical multiplexers that multiplex said second pumping light having different wavelengths in one of said plural optical multiplexers and multiplex said spare pumping light having different wavelengths in other of said plural optical multiplexers;

a second means that multiplexes plural multiplexed pumping light whose wavelengths are different from each other and splits multiplexed pumping light into plural pumping light; and

plural second optical multiplexers that input split pumping light to said plural optical transmission lines, wherein:

in case that a failure occurred at one in said plural first pumping light sources in said one or more light sources for Raman amplification not having said redundancy system or at one in said plural second pumping light sources in said light sources for Raman amplification having said redundancy system, said spare pumping light source whose wavelength band is the same one that said failure occurred is worked and said spare pumping light is emitted.

**11. (Currently Amended)** An optical amplification method in for an optical transmission system, ~~in which~~ including a plurality of one or more first light sources for Raman amplification that amplify signal light ~~transmitting~~ transmitted in ~~[[an]]~~ said optical transmission line and ~~one or more~~ a plurality of second light sources for Raman amplification that are disposed at ~~[[the]]~~ positions adjoining ~~said one or more~~ respective ones of said plurality of first light sources for Raman amplification via said optical transmission line ~~are provided~~, comprising the steps of:

amplifying said signal light by said ~~one or more~~ first and second light sources for Raman amplification;

transmitting said amplified signal light through said optical transmission line;

providing one or more spare pumping light sources for said plurality of second light sources for Raman amplification, the number of said spare pumping light sources being less than the number of said second light sources;

~~in a deteriorated state of the characteristic of said signal light by that a failure occurred at one of the pumping light sources in said one or more first and second light sources for Raman amplification;~~

detecting ~~said deterioration~~ a deteriorated state of the characteristic of said signal light amplified by one or more of said first and/or second light sources for Raman amplification; and

recovering restoring said deteriorated ~~state of the characteristic of said signal light to a normal state before deteriorated~~ an un-deteriorated state by emitting spare pumping light from at least one of said spare pumping light ~~source~~ sources,

said spare pumping light sources being operated only when required to restore deteriorated signal light disposed in one of said second light sources for Raman amplification.

**12. (Currently Amended)** An optical amplification method in an optical transmission system in accordance with claim 11, wherein:

~~in case that a failure occurred at one of said pumping light sources~~ responsive to a deteriorated state of said amplified signal light, said spare pumping light is emitted from said

spare pumping light source so that the output level of said signal light becomes the same output level before said ~~failure occurred~~ said deterioration.

**13. (Currently Amended)** An optical amplification method in an optical transmission system in accordance with claim 11, wherein:

~~in case that a failure occurred at one of said pumping light sources~~ responsive to a deteriorated state of said amplified signal light, said spare pumping light is emitted from said spare pumping light source so that the gain wavelength characteristic of said signal light becomes the same gain wavelength characteristic before said ~~failure occurred~~ said deterioration.

**14. (Currently Amended)** An optical amplification method in an optical transmission system in accordance with claim 11, wherein:

~~plural pumping said first and second light sources emitting plural pumping~~ emit light at respective first and second wavelengths ~~light of plural wavelengths are used as said pumping light source~~, and

~~plural at least one spare pumping light sources emitting plural spare pumping light of plural wavelengths corresponding to said plural pumping light sources are used as said spare pumping light source~~ for each of said first and second wavelengths.

**15. (Original)** An optical amplification method in an optical transmission system in accordance with claim 11, wherein:

outputs from said pumping light source and said spare pumping light source are controlled by respective control circuits in said one or more first and second light sources for Raman amplification.

**16. (New)** An optical amplification method for an optical transmission system including a plurality of first Raman amplifiers for amplifying signal light at a first wavelength transmitted in said optical transmission line and a second plurality of second Raman amplifiers for amplifying signal light at a second wavelength transmitted in said optical transmission line,



wherein ones of said plurality of second Raman amplifiers are disposed at positions adjoining respective ones of said first Raman amplifiers, said method comprising the steps of:

- amplifying said signal light at said first and second wavelengths by said first and second Raman amplifiers;

- transmitting said amplified signal light through said optical transmission line;

- providing a single spare Raman amplifier operating at said first wavelength for each n-number of said first Raman amplifiers, and a single spare Raman amplifier operating at said second wavelength for each n-number of said second Raman amplifiers;

- detecting a deteriorated state of said signal light in said optical transmission line at said first wavelength, and/or said second wavelength and

- restoring said deteriorated signal light to an un-deteriorated state by operating said first and/or said second spare Raman amplifiers,

- said spare Raman amplifiers being operated only when required to restore deteriorated signal light at their respective operating wavelengths.